

REMARKS

Claims 7-28 are pending and rejected in the present application, with claims 1-6 having been previously canceled. Claims 7, 8 and 19 are amended hereby.

Claims 7, 12, 19, 22, and 28 were rejected under 35 U.S.C. §102(b) as
5 being anticipated by U.S. Patent No. 5,502,003 (Ogino, et al.). Applicants point out, however, that claims 7 and 19 are amended hereby, and submit that claims 7 and 19 are now in condition for allowance.

More particularly, claims 7 and 19 have been amended to reflect that the contact layer 34 (Figs 3 and 4) of the present invention is formed of a low melting
10 point material that has a melting point of less than approximately 700 Celsius, such as aluminum, zinc, or the like. Impurities in the contact layer 34 may comprise less than ten weight percent of the contact layer 34. (*page 7, paragraph 24 of the present specification*).

As the Examiner points out, and as Applicants shall assume *arguendo*,
15 Ogino, et al., teaches forming an electrical connection to an SiC substrate by interposing a layer of tungsten (W) or nickel-tungsten (Ni/W) between the SiC substrate and the layer of nickel contact metal.

In contrast, claim 7 as amended recites in part "forming a first metal-containing layer, wherein the first metal containing layer consists substantially of
20 a metal having a melting point of less than approximately seven hundred (700)

Celsius" and "annealing the metal-containing layer and the exposed region at a temperature less than the melting point of the metal within the metal-containing layer and for a period of time in excess of ten hours". (*Emphasis Added*).

Applicants submit that such limitations are not disclosed by the cited reference,
5 and that therefore Ogino, et al., does not anticipate the present invention.

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). The identical invention must be shown in
10 as complete detail as is contained in the claims. *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). The elements must be arranged as required by the claim. *In re Bond*, 910 F.2d 831, 15 USPQ2d 1566 (Fed. Cir. 1990).

Ogino, et al., uses an intermediate layer of either W or W-Si between the
15 contact or nickel layer and the SiC substrate. The metal within the layer of W or W-Si formed over the SiC substrate is tungsten. Tungsten has a melting point of approximately 3410 C. Tungsten does not have a melting point of less than approximately 700 C. Furthermore, Ogino, et al., discloses that the annealing is carried out at a temperature of 900 C for 48 hours. The annealing is not carried
20 out at temperatures of less than approximately 700 C.

Thus, Ogino, et al., fails to disclose forming a first metal-containing layer consisting substantially of a metal having a melting point of less than approximately 700 C and annealing the metal-containing layer and the exposed region at a temperature less than the melting point of the metal within the metal-containing layer as recited in part by amended claim 7. Since Ogino, et al., fails to disclose such limitations, Applicants submit that claim 7 is not anticipated thereby. Accordingly, Applicants respectfully request withdrawal of the rejection and allowance of claim 7 and claims 8-18 depending therefrom.

Claim 19 was also rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,502,003 (Ogino, et al.). Claim 19 as amended recites in part "forming a metal-containing layer consisting substantially of a metal having a melting point of less than approximately seven hundred (700) Celsius that contacts an exposed region, wherein the exposed region includes silicon carbide". (*Emphasis Added*). Thus, claim 19 recites subject matter that is substantially similar to the subject matter recited in part by claim 7. For the same reasons given above in regard to claim 7, Applicants submit that claim 19 and claims 20-28 depending therefrom are also in condition for allowance and respectfully request same.

Claims 7-8, 10-12, 14-16, 19, 20-22, 24-26 and 28 were rejected under 35 U.S.C. §103(a) as being unpatentable over Japanese Patent Document No. JP 59-214221 A (Sano). Applicants point out, however, that claims 7 and 19 have

been amended hereby, and submit that claims 7 and 19 are now in condition for allowance.

To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). Applicants submit that the cited reference
5 fails to disclose or suggest all the limitations of claims 7 and 19, and that therefore a *prima facie* case of obviousness has not been established.

Claim 7 recites in part “forming a first metal-containing layer, wherein the first metal containing layer consists substantially of a metal having a melting point
10 of less than approximately seven hundred (700) Celsius” and “annealing the metal-containing layer and the exposed region at a temperature less than the melting point of the metal within the metal-containing layer and for a period of time in excess of ten hours.” (*Emphasis Added*). Thus, the present invention places a metal contact layer over the SiC substrate and then anneals the
15 structure at a temperature less than the melting point of the metal in the metal layer to form an ohmic contact region between the metal and the substrate.

In contrast, Sano discloses that an aluminum layer and a silicon layer are successively formed on a P-type SiC substrate. The ratio of aluminum to silicon is 89:11, but from the viewpoint of alloy and contact resistance the ratio of atoms
20 of silicon is as high as 70%. (*Constitution*). The layer formed by Sano includes a

substantial amount of silicon. The layer formed by Sano does not consist substantially of metal, as recited in part by amended claim 7.

Further, the silicon/aluminum layer is heat treated at temperatures preferably higher than 950 C for longer than 5 minutes. Aluminum has a melting point of approximately 660 C. Sano anneals at a temperature (higher than 950 C) that is much higher than the melting point of aluminum. Sano does not anneal at a temperature that is lower than the melting point of the aluminum. Thus, Sano fails to disclose or suggest annealing at a temperature that is less than the melting point of the metal within the metal layer as recited in part by amended claim 7.

For the foregoing reasons, Applicants submit that Sano fails to disclose or suggest all the limitations recited by claim 7. Therefore, Applicants submit that a *prima facie* case of obviousness has not been established in regard thereto. Accordingly, Applicants respectfully request withdrawal of the rejection and allowance of claim 7 and claims 8-18 depending therefrom.

Claim 19 was also rejected under 35 U.S.C. §103(a) as being unpatentable over Japanese Patent Document No. JP 59-214221 A (Sano). Claim 19 recites in part "forming a metal-containing layer consisting substantially of a metal having a melting point of less than approximately seven hundred (700) Celsius" and "annealing the metal-containing layer and substrate for a time period of at least approximately ten hours and at a temperature of at least

approximately 300 C". (*Emphasis Added*). Thus, claim 19 recites subject matter that is substantially similar to the subject matter recited in part by claim 7. For the same reasons given above in regard to claim 7, Applicants submit that a *prima facie* case of obviousness has not been established in regard to claim 19.

5 Accordingly, Applicants respectfully request withdrawal of the rejection and submit that claim 19 and claims 20-28 depending therefrom are also in condition for allowance which is hereby respectfully requested.

Claims 7, 9, 12-13, 15, 17-19, 22-23, 25, and 27-28 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,468,890
10 (Bartsch, et al.). Applicants point out, however, that claims 7 and 19 have been amended hereby, and submit that claims 7 and 19 are now in condition for allowance.

As discussed above, a *prima facie* case of obviousness requires that all claim limitations be taught or suggested by the prior art. *In re Royka*, 490 F.2d
15 981, 180 USPQ 580 (CCPA 1974). Furthermore, it is improper to combine references where the references teach away from their combination. *In re Grasselli*, 713 F.2d 731, 743, 218 USPQ 769, 779 (Fed. Cir. 1983). Applicants submit that the cited reference fails to disclose or suggest, and in fact teaches away from, the present invention, and that therefore a *prima facie* case of
20 obviousness has not been established.

Bartsch, et al., discloses a semiconductor device 10 (Fig. 1) having a contact layer 110 that includes a first material (nickel) and a second material (iron), i.e., permalloy. (*column 7, lines 59-65*). Both nickel and iron are present at interface 140 with semiconductor substrate 100. (*column 7, lines 25-30*). A
5 covering layer 130 of tungsten is disposed on contact layer 110, and device 10 undergoes heat treatment at about 850°C for approximately two minutes. (*column 7, lines 40-60*).

In contrast, claim 7 recites in part “forming a first metal-containing layer, wherein the first metal containing layer consists substantially of a metal having a
10 melting point of less than approximately seven hundred (700) Celsius . . . and has a composition that does not form an ohmic contact with a doped silicon carbide if annealed for a time period of less than ten hours and at a temperature less than a melting point of the metal within the metal-containing layer” and “annealing the metal-containing layer and the exposed region at a temperature
15 less than the melting point of the metal within the metal-containing layer and for a period of time in excess of ten hours”. (*Emphasis Added*).

Bartsch, et al., sputters a layer of an alloy containing nickel and iron onto the substrate. The melting point of nickel is approximately 1450 C and of iron is approximately 1535 C. The metals contained within the metal layer of Bartsch, et
20 al., do not have a melting point of less than 700 C. Thus, Bartsch, et al., fails to disclose or suggest forming a metal-containing layer substantially of a metal

having a melting point of less than approximately seven hundred (700) Celsius as recited in part by claim 7.

Further, the material of Bartsch, et al., forms an ohmic contact layer with the silicon within as short a time period as two minutes (*column 8, line 58-60*).

5 Bartsch, et al., does not disclose or suggest a material that forms an ohmic contact with the SiC only after being annealed for a period in excess of ten hours, as recited in part by claim 7.

Still further, Bartsch, et al., teaches that the heat-treatment process is preferably carried out at about 850°C for a duration of two minutes, but can be
10 extended to a duration of up to two hours. (*column 6, lines 49-55*). Bartsch, et al., teaches that the heat-treatment process can, if required, be carried out at a lower temperature, such as 800°C, but in return for a longer period of time, e.g., 30 minutes. Thus, Bartsch, et al., fails to disclose or suggest "forming a first metal-containing layer substantially of a metal having a melting point of less than
15 approximately seven hundred (700) Celsius and annealing the metal-containing layer and the exposed region at a temperature less than the melting point of the metal within the metal-containing layer and for a period of time in excess of ten hours as recited in part by claim 7.

Moreover, the Examiner states that simply because Bartsch, et al.,
20 discloses that the heating process can be performed in several hours, meaning an indefinite number more than two, that this somehow renders obvious the

requirement in claim 7 that the annealing process be conducted for more than ten hours. Applicants shall assume, *arguendo*, that the term "several" can mean a number more than two, such, as, for example, three or perhaps even four. However, Applicants submit that the term several can not reasonably be
5 construed to require a number greater than ten. In fact, Webster's dictionary defines the term several to mean a number more than two, but not very many. (see, e.g., <http://www.hyperdictionary.com/dictionary/several>).

Since the term several is not reasonably construed as encompassing a number of greater than ten, Applicants submit that Bartsch, et al., fails to disclose
10 or suggest annealing the metal-containing layer and the exposed region for a period of time in excess of ten hours, as recited in part by claim 7.

For the foregoing reasons, Applicants submit that Bartsch, et al., fails to disclose or suggest all the limitations recited in claim 7. Therefore, Applicants submit that a *prima facie* case of obviousness has not been established in regard
15 thereto. Accordingly, Applicants respectfully request withdrawal of the rejection and allowance of claim 7 and claims 8-18 depending therefrom.

Claim 19 was also rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,468,890 (Bartsch, et al.). Claim 19 recites in part "forming a metal-containing layer consisting substantially of a metal
20 having a melting point of less than approximately seven hundred (700) Celsius" and "annealing the metal-containing layer and substrate for a time period of at

least approximately ten hours and at a temperature of at least approximately 300 C". (*Emphasis Added*). Thus, claim 19 recites subject matter that is substantially similar to the subject matter recited by claim 7. For the same reasons given above in regard to claim 7, Applicants submit that a *prima facie* case of
5 obviousness has not been established in regard to claim 19. Accordingly, Applicants respectfully request withdrawal of the rejection and submit that claim 19 and claims 20-28 depending therefrom are also in condition for allowance which is hereby respectfully requested.

For all the foregoing reasons, Applicants submit no combination of the
10 cited references disclose or suggest the subject matter of the pending claims. The pending claims are therefore in condition for allowance. Accordingly, Applicants respectfully request withdrawal of all rejections, and allowance of the claims.

In the event that Applicants have overlooked the need for an extension of
15 time, an additional extension of time, payment of a fee, or additional payment of a fee, Applicant hereby conditionally petitions therefor.

The Examiner is invited to telephone the undersigned in regard to this
Amendment and the above-identified application.

Respectfully submitted,

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Date


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